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THE

ECONOMIC PROCEEDINGS

OF THE

Royal Dublin Society.

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XVI.

INJURIOUS INSECTS AND OTHER ANIMALS OBSERVED IN IRELAND DURING THE YEAR 1905.

By GEORGE H. CARPENTER, B.Sc., M.R.I.A., F.E.S., Professor of Zoology in the Royal College of Science for Ireland, and Consulting Entomologist to the Royal Dublin Society.

(Plates XXVII.–XXXI.)

[Read, May 15; Received for Publication, May 18; Published, July 21, 1906.]

CORN PESTS.

Stem Eelworms.

Tylenchus devastatrix, Kühn.

Samples of Oats suffering from the "tulip-root" disease caused by these minute thread-worms were sent from the neighbourhood of Waterford in June. As the worms were described fully and figured in my paper of last year (4, pp. 285–8, fig. 2), it is unnecessary to do more than place their occurrence on record.

CABBAGE AND TURNIP INSECTS, &c.

The Cabbage Aphid.

Aphis brassicæ, Linn.

Leaves of Swedes badly infested with this well-known "green-fly" were received in August from Nenagh. Although usually found on the Cabbage and its varieties, this insect has been often noticed on Turnips. Curtis, in 1859 (8, p. 69), mentioned the insect as especially injurious to Swedes; while Theobald (14, pp. 93–4) has recently recorded its presence on Turnips in south-eastern England.

As is usual among the Aphidæ, the "viviparous" females, that are able to give birth without male assistance to active young, are

the best-known forms of the species; and it is by the successive broods of these virgin females that the numbers of the aphids become so enormously increased, and the damage to the plants on which they feed so serious. There are both winged and wingless races of these virgin females. The winged form (fig. 1, *a*), which is about 1·7 mm. (about $\frac{1}{15}$ inch) in length, has the head, fore-trunk, eyes, and feelers black, the leg and cornicles dusky-brown, and the rest of the body yellowish-green. The wingless female (fig. 1, *b*) is somewhat larger; she has the body of a greenish-grey colour, with two series of eight dark spots on either

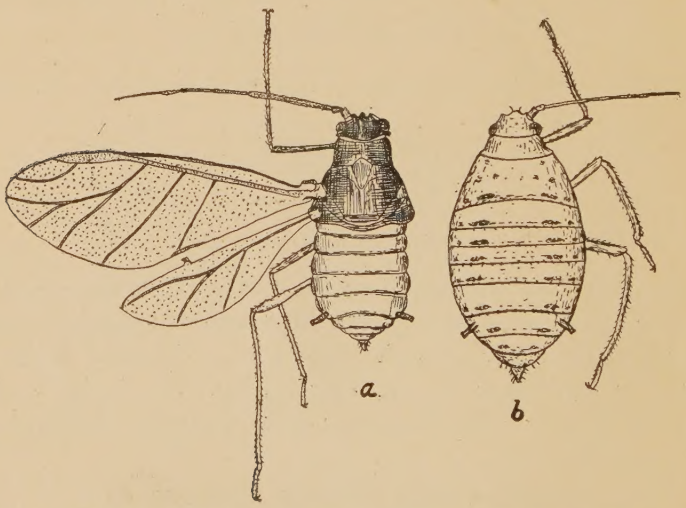

Fig. 1.—Cabbage Aphid (*Aphis brassicæ*): × 20. (*a*) Winged virgin female; (*b*) Wingless virgin female.

side of the upper surface; the feelers are green with dark tips, while the legs, eyes, and short cornicles are deep brown. But both winged and wingless forms are so coated with a whitish, mealy secretion that the true colours of the insects are, for the most part, hidden. And it is the mealy coats of the innumerable aphids crowded on the leaves that catch the eye of the observer, and make this attack so easily recognisable.

Much information as to the life-history of this aphid has lately been furnished by Theobald (15, pp. 86–90). The insects are first noticed on the leaves in May; and they do but little harm in the

earlier portion of the year. By June the leaves begin to show small blister-like areas on the upper surface, the aphids sheltering and feeding in the corresponding hollows beneath the leaves. The sap which they suck is so considerable in quantity that the leaves become yellow and white, and, finally, in late summer the aphids swarm all over the plants, exposing themselves in multitudes above the leaves as well as below, and, by their sticky secretions, converting the whole plant into a repulsive mass.

When first born the young aphid is shiny and of a bright, yellowish-green colour; the mealy coating does not appear till after the first moult. The nymphs, that are destined to develop into winged females, are dull-green with the wing-rudiments dark-green or blackish-brown; their wrinkled cuticle is covered with a mealy secretion. Theobald, to whom we are indebted for these details, states that the transformation to the winged adult condition occupies from ten to sixteen days. He tells us that "the winged females may stay on the same plant and produce live young, or they may fly off to fresh plants. The latter does not usually happen unless the whole plant is smothered by the fly. As long as there is any food they seem disposed to remain."

In autumn the males and egg-laying females are produced, whose fertilized eggs serve to carry the species over the winter. The male (fig. 2, *a*) seems never to have been observed in these countries; but a description and figure of it have been published from American specimens by Weed (17, pp. 289–90, fig. 24). The body is 1·2 mm. ($\frac{1}{20}$ inch) long, and the wing-expanse 5 mm. ($\frac{1}{5}$ inch). The head and thorax are brown or black; the hind body light greenish-brown, with transverse rows of black spots on the back. The bases of the thighs are brown, and the rest of the legs black. The short cornicles are black, and so are the feelers (fig. 2, *b*), which have the third segment as long as the fourth and fifth together, but slightly shorter than the seventh. The autumn egg-laying female (fig. 2, *c*) is wingless, 1·8 mm. long, with an acutely-pointed hind-body, and more slender than the wingless summer female (fig. 1, *b*). She is pale-green, with the head, rows of spots on the back, feelers and legs of a dusky hue; the cornicles are black. Both sexes are covered with a greenish bloom. The eggs laid by these females are elongate, oval, and ·8 mm. ($\frac{1}{30}$ inch)

in length. Of a light-green colour when first laid, they become black on exposure to the air. Weed states that they are laid "on the cabbage-leaves, especially in crevices and depressions"; but, according to Theobald's observations, it is on wild species of Brassica that they mostly occur in England; and he points out that such weeds "will always form a fruitful source of infection as long as they are allowed to exist in the immediate neighbourhood of cultivated lands." He writes further:—"That an active migration takes place between the wild plants and the cultivated can easily be followed."

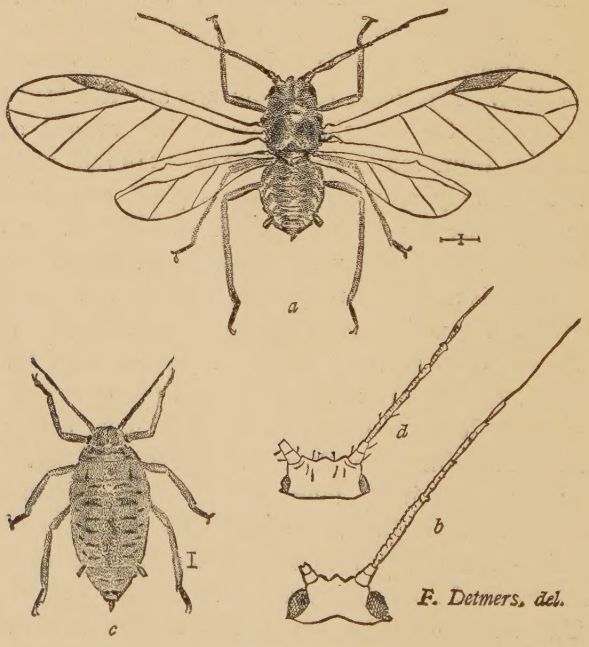

Fig. 2.—Cabbage Aphid (*Aphis brassicæ*). (*a*) Male: × 15; (*b*) Head and feeler of male: × 30; (*c*) Wingless female: × 15; (*d*) Head and feeler of female: × 30. From Weed, "Insect Life," vol. iii (U.S. Dept. Agr.).

Among the aphids were several specimens of a syrphid or hover-fly grub devouring them, while many aphids presented the hard, brown, shelly appearance which indicates that an ichneumon grub has fed within. Some of the ichneumon-flies were reared;

they proved to belong to the species *Aphidius rapæ*, Curtis (fig. 3), a member of the family Braconidæ, distinguished from the Ichneumonidæ by simpler wing-neuration, and containing a large proportion of the smaller parasitic Hymenoptera. In the genus Aphidius, which includes most of those species which attack aphids, the wing-nervures are markedly reduced in number. The present species is 2·25 mm. ($\frac{1}{10}$ inch) long. The male has feelers as long as the body, with seventeen segments; while in the female they are

Fig. 3.—Parasite of Cabbage Aphid (*Aphidius Papæ*). Male: × 36.

shorter, with only fourteen segments. The head and thorax are shining black; the feelers and hind-body dusky; the base of the feeler beneath the jaws and the stalk of the abdomen are yellowish. In the male the legs are mostly dark, with portions of the thighs, shins, and feet clear yellow; while in the female the legs are mostly yellow, with some dusky streaks.

In his monograph of the British Braconidæ, Marshall (9) described another parasite (*Aphidius brassicæ*) of *Aphis brassicæ*, and suggested that Curtis' *A. rapæ* might be in part identical

therewith. The wing-neuration of Marshall's species is, however, still simpler than that of the insect described by Curtis, the cubital areolet of the fore-wings being absent.

These predaceous insects keep down the numbers of the aphids to some extent; but in seasons favourable to the increase of the aphids they fail to act as an effectual check. In taking measures for the destruction of the aphids, it is of great importance to begin in the early stages of the attack, when the leaves on which the insects are feeding, recognised by their yellowish and blistered aspect, can be cut off and destroyed by lime or burning. Later on, when the aphids have spread over the whole plant, little or nothing can be done. Spraying with paraffin and soap-emulsion is practicable in garden-plots, but is not profitable on large fields.

The Diamond-back Moth.

Plutella cruciferarum, Zell.

The last record of serious damage in Ireland by this well-known insect is to be found in my paper of 1901 (4, pp. 144-7), when the caterpillars appeared in numbers at several localities along our eastern coast. In August, 1901, Mr. J. Johnston, Agricultural Instructor for County Waterford, sent me leaves of Swedes from a farm in east County Wexford, about six miles from the sea. He stated that the greater part of a five-acre field had been ruined by the insects. An account, with figures of the moth, was given in the paper mentioned above.

The Cabbage-Fly.

Phorbia brassicæ, Bouché.

Every year brings complaints about this familiar pest. Roots of Broccoli injured by the maggots were sent to me in June from Tralee.

The Field Slug.

Agriolimax agrestis (Linn.).

Snails and slugs are often more injurious than insects to green crops in this country, and perhaps the most destructive of all is the small, mottled Field Slug (*Agriolimax agrestis*), which often

appears in great numbers in damp weather. Eggs of this species were sent to me in November from Waterford by Mr. J. Johnston. They had been laid, as is usual, in a cluster, and close to the root of a Swede. The leafage of Cabbages and Turnips suffers especially from these slugs; but they attack all kinds of vegetation.

The family (Limacidæ) to which the present species belongs may be distinguished from our other native family (Arionidæ) by the absence of a caudal gland, and the somewhat backward position of the pulmonary opening (behind the middle of the mantle). In the genus Agriolimax the mantle is marked with concentric wrinkles, not with a deep, horseshoe-shaped groove (as in Amalia), and there are no lateral stripes or bands along the side of the slug's body (as in Limax). The hinder end of the animal has a dorsal keel (fig. 4).

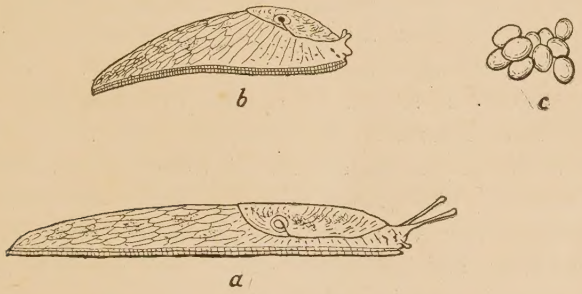

Fig. 4.—Field Slug (*Agriolimax agrestis*). (*a*) Extended; (*b*) retracted; (*c*) eggs: × 1½.

When *Agriolimax agrestis* is fully extended, it measures about 36 mm. (1½ inch) in length; the mantle is about one-third the length of the body, and its mucous secretion is milky in appearance. The colour of this species is very variable. Usually it is yellowish with grey mottling; but it is often uniform grey or brown, and specimens from the western islands are sometimes quite dark. With respect to its feeding habits, Scharff (13, p. 528) remarks:—"The damage done by it in the garden, as well as in the field, is enormous. It begins its ravages in the evening, soon after sunset, and feeds the whole night through until the morning, when it retires for the day into worm-burrows, or underneath

stones and clods of earth. It seems to be little affected by weather or climate."

The eggs (fig. 4, *c*) are almost globular and hyaline in appearance. They measure from 2 to 2·5 mm. in diameter. It has been stated that a single individual may produce over 300 eggs, which are laid in clusters of from 20 to 30. According to Collinge, egg-laying is continued from the end of March until the end of November (7, p. 16).

Dressings of salt or lime have usually been found most effectual in killing slugs. Theobald (16, pp. 209–211) recommends that salt should be applied at the rate of four or five bushels to the acre, and lime at ten or twelve bushels to the acre—two dressings being applied after sunset or before sunrise, at an interval of about a quarter of an hour, after heavy rain, when the slugs are active. The reason for the two dressings is that the slimy secretion of the slugs protects them from the effect of the first application, taking up the powder, and allowing the animals to escape. But they are unable to secrete a second lot of the protective slime after a sufficiently short interval. Rubbish-heaps and stones form an attractive shelter for slugs, and should therefore be cleared away as far as possible ; while heaps of mould, which are often selected for egg-laying, may be advantageously dressed with quicklime. Rooks, starlings, and blackbirds often feed greedily on slugs, and thus assist in keeping down their numbers.

MANGOLD INSECTS.

The Mangold Fly.

Pegomyia betæ (Curtis).

As in 1904, this insect attracted notice in various parts of the country. Leaves, blistered through the presence of its maggots, were received from County Armagh in June, and from Counties Galway and Clare in July. An illustrated account of this fly, and the various stages in its life-history, will be found in my last paper (4, pp. 289–291, Plates XXIII., XXIV.).

POTATO INSECTS.

Potato Flea-beetle.

Psylliodes affinis (Payk.).

These little beetles—previously described and figured in the present series of papers (4, pp. 254-5)—were reported as again injurious to Potato-leaves in County Meath during June, and in County Antrim during July.

Ghost Swift-Moth.

Hepialus humuli (Linn.).

Potato-tubers growing in reclaimed bog-land near Enniskillen were attacked in March by caterpillars of this moth, which was described and figured by me in 1903 (4, pp. 195-7, fig. 1, Plate VII.A).

ORCHARD INSECTS, &c.

The Winter Moth.

Cheimatobia brumata (Linn.).

Plates XXVII. and XXVIII.

This moth during 1905 might have been regarded as the "insect of the year" from the economic point of view. My attention was first called to it during May, when Mr. T. S. Porter forwarded branches of Apple from County Fermanagh on which the caterpillars were ravaging the foliage. During June I noticed in demesnes in various parts of the west and south of Ireland several kinds of trees whose leaves were badly attacked by the caterpillars. For this insect is by no means exclusive in its feeding habits, and devours with avidity the leaves of many kinds of trees.

The moth (Plate XXVII.) is one of several species of the family Geometridæ, in which the wings of the female are so excessively reduced that she is unable to fly. The male has light-brownish

forewings, densely sprinkled with dusky scales and traversed by dusky stripes; his feelers have bundles of strong bristles. The vestigial wings of the female are whitish-grey with darker markings. The outspread wings of the male measure 25 mm. (about 1 inch) across. As its name implies, the moth is abroad in autumn and winter, making its first appearance usually about the middle of October, while in some seasons individuals may be observed as late as January. The flightless females, after emergence from the pupa, which is buried in the ground, climb up the trunks of the trees on which the males seek them. Then they lay their small cylindrical eggs in groups at the bases of the buds or in cracks of the bark.

From these eggs the caterpillars are hatched in March or April, just when the young leaves of the trees are beginning to burst from the buds. The caterpillars are at first greyish in colour, but they soon become green or yellowish with a dark line along the middle of the back and a white stripe along either side, the head being mottled with brown or black. As usual with Geometrid caterpillars, the two hinder pairs of prolegs alone are developed, so that the caterpillar walks by "looping"—bending the long, central region of the body where prolegs are absent. But these caterpillars are rather stouter in build than most "loopers." They eat blossoms as well as foliage leaves, and trees on which they are present in large numbers are stripped almost completely (Plate XXVIII.). When fully fed—about the month of June—they let themselves down to the ground by silken threads, spun from the mouth, and pupate a few inches below the surface of the soil. From the underground pupa, as mentioned above, the moth emerges in autumn or winter, the female climbing up the tree-trunk to lay her eggs.

This habit of the moth enables orchard-owners to prevent the laying of eggs on the trees, and the consequent presence of caterpillars in the succeeding year, by the well-known plan of placing a "grease-band" around the tree-trunk, to serve as a trap for the ascending females. A band of grease-proof paper about 6 inches wide is tied carefully round the trunk with two pieces of string—one near the upper and the other near the lower edge—and is then covered with cart-grease not mixed with tar. The grease must be

renewed periodically, so that the band may never get dry. The bands are best placed about 4 feet from the ground; they should be kept in order throughout the autumn and winter. If the trees are so young as to need supporting-stakes, these should be banded also (Ormerod, 11, pp. 162-4).

The only effective application for destroying the caterpillars when they are feeding in spring and summer, is some kind of arsenical spray; soapy emulsions are of little or no use. The two sprays generally recommended are "Paris green" and "lead arsenate." Paris green is an aceto-arsenite of copper; it should be obtained in the form of paste, and used at the rate of 1 lb. to about 200 gallons of soft water. The poison is not dissolved in the water, but remains in suspension, so that the mixture should be frequently stirred to keep the strength uniform. A fine spray is most effective, and the trees should never be "swilled" with the fluid. It has been found advantageous to add flour to the mixture, about 10 lb. to 1 lb. of the green.

Arsenate of lead is prepared by dissolving 1 oz. arsenate of soda in warm soft water, and mixing it with 12 gallons of soft water. After this a solution of 3 oz. acetate of lead is added, together with 1 lb. of treacle.

The Green Pug-Moth.

Chloroclystis rectangulata (Linn.).

The Apple-branches from County Fermanagh, which were infested with the Winter moth caterpillars just described, also harboured among the blossoms many caterpillars of the handsome little Pug-moth, *Chloroclystis rectangulata*. Both forewings and hindwings in this insect are green, with black or grey bands, while the abdomen, which is crested, has a blackish spot on either side near the base. The wing-spread measures about 18 mm. ($\frac{3}{4}$ inch). The moths are flying about midsummer; and the eggs which the females lay remain unhatched through the winter. In April and May the caterpillars appear and begin to feed upon the blossoms. The caterpillar is of a yellowish-green colour, with a broad stripe either dark-green or claret-red down the back. These caterpillars feed on the petals of both Apple and Pear blossoms.

The December Moth.

Pœcilocampa populi (Linn.).

An unusual enemy of Apple-trees has to be recorded in this moth, whose caterpillars were sent from Newcastle, Co. Clare, at the end of May, with the information that they were proving "very injurious." They were feeding on the Apple-foliage when received.

The moth belongs to the family of the Lasiocampidæ, characterized by the feelers often comb-like in both sexes, the reduced sucking-trunk, the robust body, and the usually broad and ample wings of the moths, which are, as a rule, brown in colour. The caterpillars are robust and hairy, and spin an exceptionally dense cocoon for the protection of the pupa; whence their common name of "eggars." In the present species the wing-spread is about 38 mm. (1½ inch) or more. The forewings are markedly elongate, and the hindwings rather short; both pairs are thinly covered with scales giving a blackish-brown ground-colour, traversed by a white central line; the forewing is tinged with reddish-brown at the base and along the front margin. The moths fly in autumn and early winter rather late at night, and the eggs remain unhatched till the succeeding March or April, when the caterpillars appear, feed quickly, and become fully grown by May or June. The caterpillar is bluish-grey, with a double row of grey or brown, black-edged spots along the back, and a row of large black spots along each side. Further dashes of black and orange or crimson may be present in the dorsal region, and the under-surface is orange with black spots. Barrett (1, p. 3) gives oak, elm, birch, sallow, alder, hawthorn, lime, ash, aspen, and poplar as the usual food-plants of this insect, and mentions that the appearance of the caterpillar is admirably adapted for concealment as it clings to a branch of its tree. The red-brown pupa is enclosed in a dark grey-brown cocoon among leaves and rubbish on the ground at the foot of a tree, or a few inches below the surface of the soil.

The arsenical sprays mentioned above in connexion with the Winter Moth caterpillars would be found equally effective against the present insect.

The Pith Moth.

Plate XXIX., A.

Blastodacna vinolentella, Herr-Schäff.

Shoots of Apple-trees bored by the caterpillars of this moth were brought to me at the end of March, from Donnybrook, near Dublin, by Mr. T. S. Porter. This is a small moth (fig. 5, *a*) belonging to the great Tineoid group, recognisable by their elongate wings, which are—especially those of the hinder pair—bordered

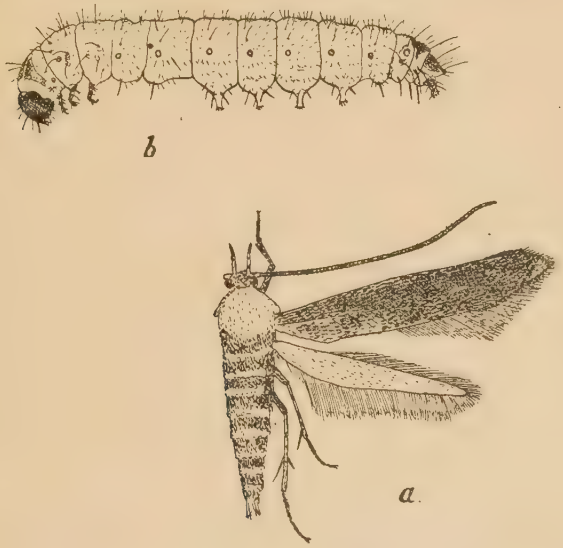

Fig. 5.—Pith Moth (*Blastodacna vinolentella*). (*a*) Male moth; (*b*) Caterpillar: × 8.

by long, delicate fringes. In the present species, which measures 10 mm. ($\frac{2}{5}$ inch) across the outspread wings, the head is blackish, and so are the forewings, except for a few white streaks and scales, while the hindwings are dark-grey (Meyrick, 10, p. 678). The allied species *B. atra*, Haworth, whose caterpillars feed during autumn on the berries of the hawthorn, seems to have been confused with the present moth, as both are included by many writers under the name *Laverna atra*. The true *atra* is characterized by a white (not blackish) head, and its larval habit is quite different.

The moth is generally observed in July, and it is believed that the eggs are laid on the Apple-leaves, which serve as the earliest food of the larva. Towards the close of the year, while still quite small, the caterpillar bores into a shoot, and remains through the winter just beneath the bark. In early spring the caterpillars are to be found in the centre of the young shoots—hence the name "pith moth"—where their presence leads ultimately to the fading and death of the leaves. The small, round hole through which the young larva has bored into the shoot can be distinguished—usually close to the origin of a bud (Plate XXIX., A).

When fully grown, the caterpillar (fig. 5, *b*) is 8 mm. ($\frac{1}{3}$ inch) long, of a dull, fleshy-brown colour, with the head, first trunk-segment, and tail-segment deep chestnut-brown. Each abdominal segment carries six brown bristle-bearing spots. Towards the end of June the caterpillar pupates near the tip of the shoot in which it has fed; the pupa is yellowish, suffused with reddish-brown in front and behind. The moth emerges usually early in July.

No application (unless possibly an arsenical spray in late summer when the young caterpillars are feeding on the leaves) can be of any use against these insects, which live so well protected within the shoots. The removal and destruction of the injured shoots, with their contained caterpillars, in spring should be carried out wherever possible. The presence of the caterpillar is easily seen by the drooping of the leaves; and as this attack is most prevalent on young trees, the pruning of the damaged shoots is quite possible.

Wireworms.

Agriotes lineatus (Fab.).

Plate XXIX., B.

Wireworms—the well-known hard, elongate grubs of the click-beetles (Elateridæ)—are too well known to farmers as destructive to the roots of all kinds of field-crops. An exceptional case of damage due to them was brought to my notice in November by Mr. W. F. Gunn, who forwarded, from County Carlow, woody roots of Peach-trees gnawed and tunnelled by grubs of the best-known of all the species—*Agriotes lineatus* (Fab.). Mr. Gunn

informed me that the wireworms had been almost cleared out of one bed by an application of the underground insecticide known as "vaporite," while an undressed border (from which the specimen forwarded to me had been taken) contained hundreds of the grubs.

The Gooseberry Saw-fly.

Nematus ribesii, Scop.

Specimens of the destructive caterpillars of this well-known Saw-fly were sent from Portlaw, County Waterford, at the end of May by Mr. J. Johnston; and from Mullingar early in June by Mr. M. Horgan, County Agricultural Instructor for Westmeath. In both cases it was stated that some of the bushes had been almost stripped of their leaves.

The female fly, which measures about 9 mm. ($\frac{3}{8}$ inch) in length, and has a wing-spread of 13 mm. ($\frac{1}{2}$ inch), has a black head, a yellow, black-spotted fore-body, and a clear, yellow abdomen; the legs are yellowish or whitish, with the tip of the shin and the foot-segments black. The male (fig. 6, A) has thorax and abdomen almost all black; he is rather smaller than the female. The flies usually appear early in May, and the female lays her eggs beneath the leaves both of gooseberry and currant bushes, cutting, near the larger veins, incisions in the lower leaf-skin, wherein the eggs are lodged. The caterpillars, like those of Saw-flies generally, have seven pairs of abdominal prolegs, in addition to the three pairs of jointed, clawed legs on the thoracic segments. The large number of prolegs serves to distinguish them from the caterpillars of moths, which have rarely more than five pairs. The caterpillar of *N. ribesii*, when first hatched, is 2 mm. ($\frac{1}{12}$ inch) long, greenish-white, with black head and black spots on the body-segments. In this young stage they feed in a company beneath the leaf in which the eggs were laid, and their presence may be detected by numerous small pin-holes piercing the leaf. It is of great importance to recognise, remove, and destroy infested leaves at this stage, as the insects will thus be killed before they can spread over the plant. If unmolested, they soon forsake the single leaf which can no longer provide food for them all, and migrate to other leaves and

shoots. Through most of their lives the caterpillars are of a green colour, with black heads, and numerous black spots on the trunk-segments, the hindmost having, in addition, a large, central black patch (fig. 6, B). In its last stage, the caterpillar is about 25 mm. (1 inch) long, the black spots have disappeared, and the head is paler. The body is now of a green colour, with the first and hindmost segments orange. As they increase in size, the caterpillars become very voracious; and if they are present in numbers, they strip the bushes of all their leaves. They become full-grown about four weeks after hatching. Then they bury themselves an inch or two deep in the soil, and spin oval-brown cocoons (fig. 6, c) within which they turn to pupæ. After a pupal stage of three weeks, the flies become fully developed, and make

Fig. 6.—Gooseberry Sawfly (*Nematus ribesii*). (*a*) Male: × 3; (*b*) Caterpillars feeding: slightly enlarged; (*c*) Cocoon: slightly enlarged. From Ormerod's "Reports" (after Fletcher).

their appearance to lay their eggs in the leaves, and start a fresh life-cycle which runs the same course as before. The caterpillars hatched from the eggs of the second summer generation of flies bury themselves and spin cocoons, but they do not pupate for several months, and the flies do not emerge until the succeeding spring. It is this habit of the insect—wintering in cocoons a few inches beneath the surface of the soil—that indicated long ago the best means for preventing a recurrence of the attack. The earth around the bushes should be removed during autumn or winter to

a depth of three or four inches, and buried deeply, being afterwards replaced by fresh soil. In this way the insects within the cocoons will be prevented from completing their development.

For spraying bushes during the feeding-time of the caterpillars, three applications have been found most effectual: hellebore mixture, Paris green, and London purple. But none of these poisonous insecticides must be used within six weeks of the fruit-gathering. An ounce of hellebore is mixed with 3 gallons of water and 2 oz. of flour; the mixture must be kept well stirred. The arsenical pastes (London purple or Paris green) must be mixed at the rate of 1 lb. to 200 gallons of water, kept well mixed while in use, and applied as a fine spray. To prevent disappointment, it must be remembered that the caterpillars must be allowed time to eat the poisoned foliage before they will die; and not until two or three days after spraying will they all be killed.

The Currant Root-Aphid.

Schizoneura fodiens, Buckton.

Soil from around the roots of Currant-bushes in County Waterford, that was brought to me in October by my friend Dr. G. H. Pethybridge, contained specimens of this aphid, which is mentioned by Buckton (3, vol. iii., pp. 94–6) as sometimes injurious to the roots of black currant. The wingless female is 1·4 mm. ($\frac{1}{18}$ inch) in length, globose and shining, of a ferruginous yellow colour, with the head rich brown. The eyes are absent or much reduced in size, and the cornicles on the abdomen are, as is usual in this genus, not developed as tubes, but present only as openings on the dorsal surface of the fifth abdominal segment. Besides this wingless form, nymphs with wing-rudiments were also present. These develop into the winged form, which is, according to Buckton, 1·8 mm. in length, of a shining-brown colour, with a slaty-grey abdomen. Buckton records that he discovered twenty individuals of this species in a nest lined with cottony fibres.

Kainit, which, hoed into the soil, has been found effectual against the root-living form of the "American blight" Aphid (*Schizoneura lanigera*), might be tried if the present species were found to be seriously injurious.

Strawberry-Eelworms.

Aphelenchus fragariæ, Bos.

Plates XXX. and XXXI., A.

In the month of May Mr. E. D'Olier kindly supplied me with Strawberry plants from Bray, County Wicklow, apparently suffering from the "cauliflower" disease described in 1891 by Ritzema Bos (2, p. 1) and Ormerod (12, pp. 126–133). The appearance of one of the plants is shown in the accompanying photograph (Plate XXXI., A). The stems become greatly swollen, and the buds, stunted and crowded together, remain in an undeveloped state (presenting the appearance of a small cauliflower), or give rise to monstrously deformed blossoms. Examination of the plants revealed the presence of numbers of small Nematode worms, which were found, on examination, to agree closely with Ritzema Bos' description and figures of *Aphelenchus fragariæ*.

The genus Aphelenchus is nearly allied to Tylenchus, to which belongs the well-known species that causes "tulip-root" disease in Oats. Both genera contain many species of minute Nematodes ("eelworms"), possessing in the mouth a spicule with swollen base, by means of which they pierce the plant-tissues that supply them with food. But while in Tylenchus the gullet is prolonged behind the swollen muscular pharynx, and forms a second swelling just in front of the intestine, in Aphelenchus, the intestine begins immediately behind the pharynx (Plate XXX. *p.*). The excretory vessels of Aphelenchus open just behind the pharynx, relatively farther forward than in Tylenchus. The male Aphelenchus has no bursa around the genital opening such as is usually found in Tylenchus. In most other structural features the two genera are similar.

In the present species (*A. fragariæ*) the male (Plate XXX., A) measures about ·6 mm. in length; the female (Plate XXX., B) ·75 mm. or more. The genital opening of the male is, as usual, far back, close to the anus, while the vagina of the female is about one-third of the body-length from the tail-end. Specially characteristic of the species are the constriction of the tail-region just behind the

anus, and the narrowness of the front end of the intestine just behind the gullet.

The outbreak of this disease recorded by Miss Ormerod in 1891 occurred in south-eastern England (Kent). I am not aware that it has since been noticed in the British Islands, and it is certainly new to this country. Mr. D'Olier has kindly informed me that the plantation now affected was made in August, 1903, on ground which had been used for Potatoes and Rye-grass alternately for more than twenty years. Probably the worms were brought to the land with runners from plants already affected, but in the new plantation 45 out of 225 plants were diseased. "Royal Sovereigns" were worse than any other variety. Sulphate of potash was applied without any beneficial result, and ultimately the injured plants were all burnt, and the soil dressed with lime.

White Ringed-Worms.

Fredericia, sp.

Roots of Strawberries attacked by Enchytræid worms were received from Bray in November. Reference to the damage done to garden-plants by these worms has been made in my previous papers (4, pp. 202–3, 297–8).

Strawberry Click-Beetle.

Adrastus limbatus (Fab.).

A new enemy to Strawberries was noticed in July, when fruit in which the small click-beetle *Adrastus limbatus* was burrowing was received from Limavady. The genus Adrastus (of which *A. limbatus* is the only recorded Irish species) is closely allied to Agriotes, to which the common, destructive "wireworms" belong. Adrastus may be distinguished by the foot-claws being toothed; whereas in Agriotes they are simple. *A. limbatus* is an elongate beetle (fig. 7), measuring 6 mm. ($\frac{1}{4}$inch) in length, and only 1·5 mm. in breadth. The head and forebody are shining black, the latter with pale-grey hairs; while the feelers, wing-cases, and legs are pale ochreous yellow. This beetle occurs commonly all over Ireland, inhabiting, for the most part, clearings in woodlands,

where specimens can be readily swept off the herbage on which they live. It will be of interest to see if there is any general tendency on the part of the species to make succulent fruits a common source of food-supply. On the present occasion it was

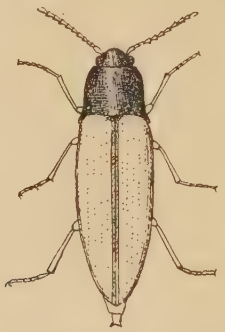

Fig. 7.—Strawberry Click-beetle (*Adrastus limbatus*) : × 10.

suggested that traps in the form of sunken jars, baited with treacle, or other sweet substance, might be successful in catching many of the insects.

GARDEN INSECTS.

White Springtails.

Lipura ambulans (Linn.).

Every year seems now to bring records of injury by one or both of the species of Springtail mentioned in my former papers (4, pp. 251–3, 293–4). Specimens of the white species (*Lipura ambulans*) were received in April from County Armagh, with the information that they were damaging the roots of garden flowering plants and succulent vegetables. Lime and soot had in this case been applied to the soil without success.

Root Mites.

Rhizoglyphus echinopus, Furnouze & Robin.

Tulips attacked by these small mites were sent in May from County Kilkenny by Mr. O. W. H. Roulston. A description and figure of the mite, and an account of the injury which they do to bulbous plants, have been given on a previous occasion (4, pp. 258–260).

STORE AND HOUSE INSECTS.

The Rice Weevil.

Calandra oryzæ, Linn.

Plate XXXI., B.

A sack which had contained wheat imported from South Australia to Belfast was sent to me in November by my friend Mr. R. Welch. The sack was so full of Rice Weevils (*Calandra oryzæ*) that its inside appeared for the most part black. It was stated that the whole cargo had been similarly affected.

This species, and its near ally *Calandra granaria*, Linn., are frequently found among stored grain. They are specially common

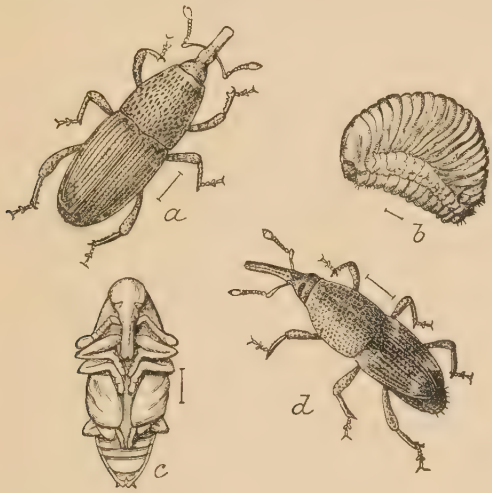

Fig. 8.—Grain Weevils. (*a*) *Calandra granaria*; (*b*) larva; (*c*) pupa; (*d*) *Calandra oryzæ*: × 8. From Chittenden, "Year Book," U. S. Dept. Agr., 1894.

in ships' cargoes. The family of the Weevils (Curculionidæ) are characterized by the prolongation of the head into a prominent snout, from which the elbowed feelers arise, by the short, rigid, and conical palps of the first maxillæ, and by the feet with only four evident segments. The group of the family to which Calandra belongs comprises weevils with narrow bodies, and long, slender snouts. The weevils have rather short, stout, fleshy grubs, with wrinkled skin, and without legs (fig. 8, *b*).

Calandra oryzæ and *C. granaria* are each about 5 mm. ($\frac{3}{16}$ inch) in length. In both species the head and forebody are strongly punctured; but the puncturation is coarser in *C. granaria* than in *C. oryzæ*, which is narrower in the body (fig. 8 *a*, *d*). Both species are deep brown in colour, but *C. oryzæ* has two reddish spots on each wing-case, and *C. granaria* has a more shiny surface. *C. oryzæ* has the hindwings well developed for flight, but in *C. granaria* they are so reduced as to be useless.

The female beetle makes holes in the grains with her snout, and lays her eggs there—in wheat usually—one egg in each grain, and the larva lives inside, devouring all the internal food-supply of the seed. The whole life-cycle lasts about six weeks, and it has been computed that a single pair will give rise to 6,000 descendants in a year.

The results of some very interesting experiments on the conditions of life most favourable to these weevils have been lately published by Cole (6). A temperature of about 80° F. suits the insects best; frost is fatal to both species. *C. granaria* can endure a lower temperature than *C. oryzæ*; while the latter can stand a higher temperature than *C. granaria*—a result which might have been expected since India is the native country of *C. oryzæ*, though it has now been spread by commerce to all parts of the world. Moisture is absolutely necessary to the welfare of the weevils, which rapidly die in a dry, ventilated atmosphere. *C. oryzæ* does not succumb to dry conditions so quickly as *C. granaria*. The most surprising result of all is that the beetles thrive best, and will only breed freely, in an unventilated atmosphere that has become surcharged with carbonic acid gas. Even in air containing 80 per cent. of CO_2 some beetles lived for many days; and a fair proportion survived for fifteen days under the receiver of an air-pump at a pressure of only 1 inch of mercury, provided that water-vapour was present. Without the proof afforded by such experiments, it would hardly be believed that an insect could endure such an almost complete absence of oxygen. Sea-water is not fatal to the weevils. From these facts it is easy to understand how the hold of a ship is a most favourable environment for these insects.

The practice of removing the weevils and their excreta, together with the light, partially-eaten grains, from infested cargoes by

sifting under a strong air-blast, before the grain is ground or sold, seems general among importers. In this connexion Cole points out that the grain thus screened contains numerous eggs and larvæ; and he had no difficulty, with favourable conditions, in rearing in about six weeks an innumerable multitude of *C. oryzæ* from barley which had been pronounced "sound" by practised Liverpool corn-merchants.

The Mottled Willow Moth.

Caradrina quadripunctata, Borkh.

The caterpillars of this moth are common in grass and on cereals during the harvest months, and they are often brought in with the crops and stacked in hay- and corn-ricks, where they find shelter for the winter. A curious and inexplicable case of the invasion of a dwelling-house by these insects was brought to my notice during September and October. Specimens were sent with the statement that during the last three years they had come in hundreds down the chimneys of a house at Kilbeggan, County Westmeath, making their way into wardrobes, drawers, and presses. Fires in the grates, and the burning of sulphur in the rooms, had not availed to banish them. It was said that for ten years past the surroundings and the condition of the house had remained unchanged.

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EXPLANATION OF PLATE XXVII.

PLATE XXVII.

Winter Moth (*Cheimatobia brumata*, Linn.). Male (left). Female (right). Two Caterpillars feeding below. × 1½.

Photograph by T. Price.

M'Farlane & Erskine, Edinr.

EXPLANATION OF PLATE XXVIII.

PLATE XXVIII.

A. Apple branches attacked by Caterpillars of Winter Moth (early stage).

B. Apple branches (later stage), when almost stripped of leaves.

Photographs by T. Price.

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EXPLANATION OF PLATE XXIX.

PLATE XXIX.

A. Pith Moth (*Blastodacna vinolentella*, H.-S.) with three injured Apple-twigs, showing (from left to right) entrance of young larva beneath bark, young larva feeding under bark, and older larva feeding in pith. Slightly enlarged.

B. Wireworms of *Agriotes lineatus*, Fab., feeding in woody roots of Peach.

Photographs by T. Price.

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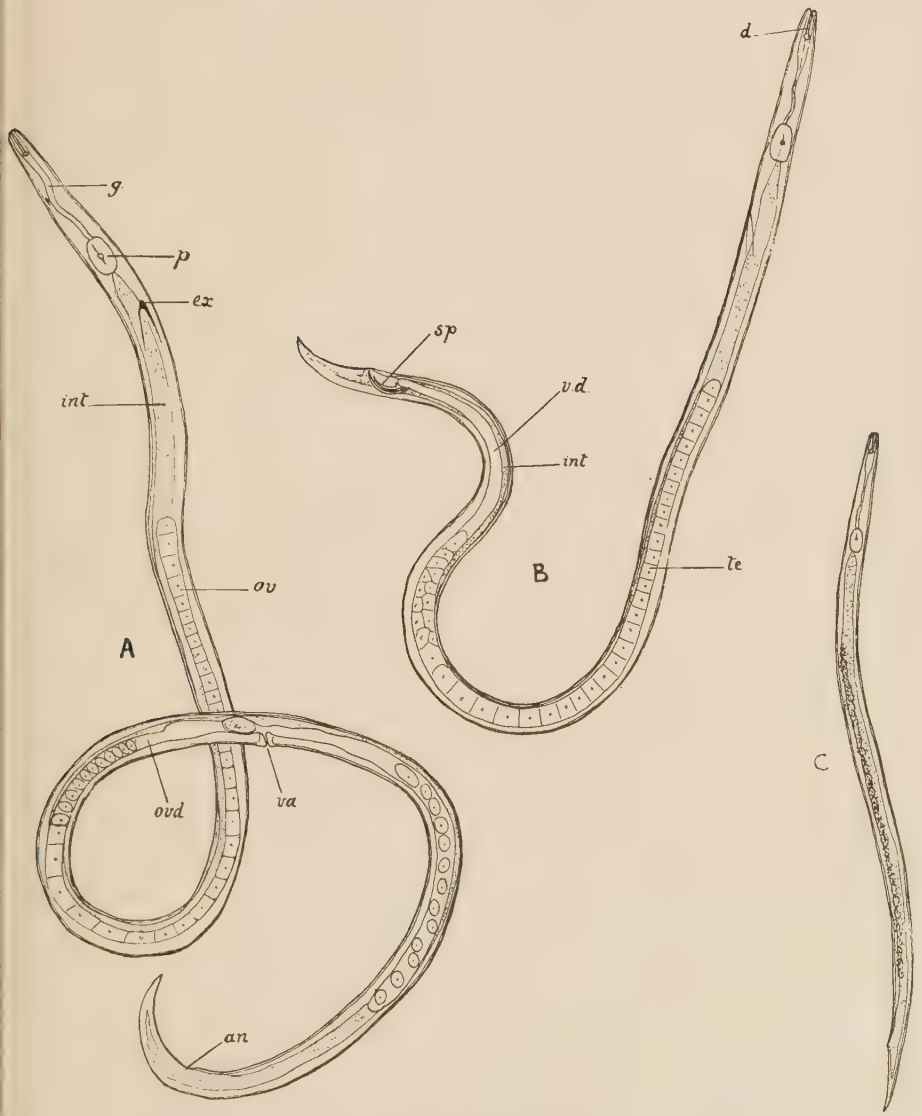
EXPLANATION OF PLATE XXX.

PLATE XXX.

Strawberry Eelworms (*Aphelenchus fragariæ*, J. R. Bos). × 360.
A. female ; B. male ; C. young.

d. stylet in mouth ; *g.* gullet ; *p.* pharynx ; *int.* intestine ; *an.* anus ; *ov.* ovary ; *ovd.* oviduct ; *va.* vagina ; *te.* testis ; *v.d.* vas deferens ; *sp.* spicules ; *ex.* excretory pore.



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EXPLANATION OF PLATE XXXI.

PLATE XXXI.

A. Strawberry Plant, attacked by Eelworms.

B. Corn-sack infested with Rice Weevils (*Calandra oryzæ*).

Photographs by T. Price.

A

B

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THE

ECONOMIC PROCEEDINGS

OF THE

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